The Lease Pumper's Handbook

CHAPTER 14

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Section A

INTRODUCTION TO WELL TESTS

A-1. Introduction to Well Testing.

There are many reasons for testing a well, and several distinct types of well tests. Because of the wide variety of problems that may be encountered, well tests may have slightly different purposes and names. This is understandable because of unitized reservoirs and dozens of variations in enhanced recovery.

Many people in charge of testing wells will also develop their own terminology for determining what to call a particular test. Even after hearing what the company supervisor calls the test, it may have little meaning to others until the test procedure and the purpose of the test is described in detail. However, this book uses the most widely accepted names for testing wells.

Unless wells are tested at regular intervals, the lease operator cannot determine how oil comes from each well and which have production problems. Other reasons are just as important. Economic gain is always important, but if the lease enters the enhanced recovery phase with water flood or secondary recovery practices, analyzing well tests is the primary method of determining the success or failure of an enhanced recovery process. Since artificially occurring forces in the formation such as secondary and tertiary recovery can increase the amount of oil recovered from a reservoir, well tests trace the success and failure of enhanced recovery.

A-2. Pre-Test Preparation.

To accurately test a well, the lease pumper must prepare the well for testing. There are two ways of preparing the well for a test—either produce it every day normally or shut it in one day before the test. The pumper must know what type of test is to be taken and do the best possible job of preparing the well for the test. For some tests, the bottom hole shut-in pressure prior to performing the test may be needed.

Shutting the well in. In flowing wells, some tests require that the well build up to its maximum wellhead pressure. When a well is to be tested from a shut-in condition, the casing and master tubing valves are closed so that no gas, oil, or water is produced. After closing the valves, noise should not be detected from the wellhead. If noise can be heard, this indicates that a valve is leaking and, until an additional valve is closed or the valve has been repaired or replaced, an accurate test cannot be made. As with pumping wells, when a circulating line has been run from the tubing to the casing so that inhibitors or chemicals can be injected at the wellhead, the circulating line valve must also be closed.

Twenty-four hours is the standard amount of pre-test shut-in time. Different wells, however, may be tested after a longer or shorter shut-in period. If the formation pay section is composed of coarse sandstone

with a high porosity, 16 hours may provide enough time for the wellhead pressure to build to its maximum pressure so that the test may begin. If the formation is composed of tight shale (clay compressed into rock) and has a lower porosity, it may require more than one day for the well to build up to maximum pressure. Experience will teach the pumper how much shut in time is necessary to allow the pressure to build up in each well to its maximum level before testing can begin.

The pressure will build up rather rapidly when the well is first shut in but will slow down over time. The longer it is shut in, the slower will be the rate of pressure increase until it levels off at the maximum pressure.

Normalizing production by producing the well before testing. *Normalizing* a well means that the well must produce its normal average amount of oil, water, and gas each day for several days prior to testing. If a well has been purposely shut in for one or more days, turning it back on may produce far more oil than if it had been producing normally.

As an example, the first day a well returns to production, it may produce 125% of a normal day's production. The second day, it may produce 112% of a day's production. On the third day it may produce 105% production, and on the fourth day, it may be almost back to 100% of normal production. After three days, it may have made up 42% of one day's production. Each well produces differently from every other well.

Many factors influence whether a pumping well is producing a normal amount of oil and gas or if it is developing a problem. Experience will give the lease pumper additional causes. These same reasons will also factor into the problems encountered when testing a well.

A-3. Preparing the Tank Battery for Testing a Well.

Care must be taken in preparing the tank battery to receive and measure the produced fluids. The valves in the lines must be turned to the correct positions to direct the produced oil to a stock tank where it can be measured, the gas metered before entering the gas sales system, and the free water measured through a liquid measuring device or by other methods.

In a large tank battery, the well to be tested will be switched manually or automatically into the test separator (Figure 1). The gas is measured and recorded on a chart or in a computerized recorder, and the oil and water is directed to a metering heater/treater. The oil is directed to the oil holding tank. The water is also measured then directed into the water disposal system.

Figure 1. A test separator.

In small, low production tank batteries, oil and water may be diverted through the test separator, and all of the liquid produced into the same tank. Before the test begins, the total liquid in the tank is gauged, and the exact amount of liquid in the tank determined. The second step is to thief the tank and determine the oil/water interface level. A shakeout of the oil may also be

taken to determine the suspended BS&W percentage. If needed, the API gravity and temperature will be taken. The number of barrels of oil and water in the tank is computed.

At the end of the test, the new fluid level is gauged and recorded and thiefed in the same manner as the first time. The total volume of oil and water in the tank is computed again and, by simple subtraction, the amount of oil and water produced is easily calculated. The acquired water can be circulated out of the tank into the disposal system. This assists in cleaning the bottom of the tank.

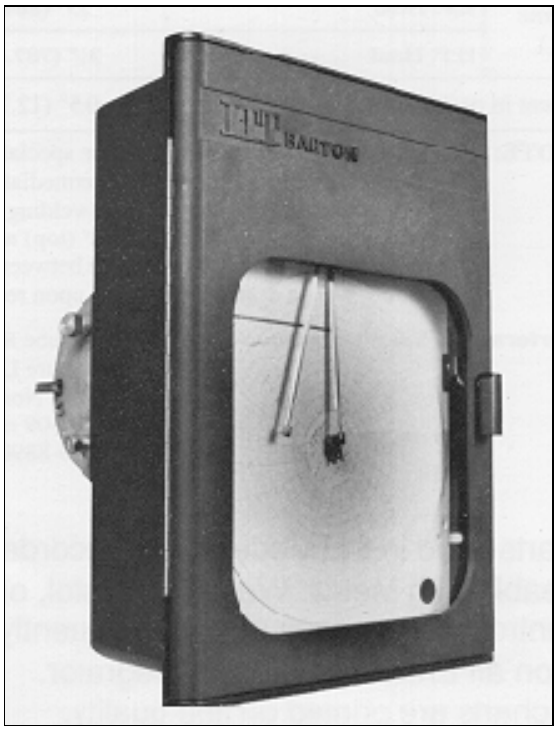

Figure 2. A differential, static, and temperature gas recorder.
(courtesy of ITT Barton)

The natural gas must also be measured. By turning to the prior well test information in the lease records book before the test is started, the correct gas meter orifice plate can be selected, and the gas system set up for the test (Figure 2). The ink pens on the chart should be moved lightly at the beginning to ensure that they are feeding ink and the correct time of day when the test begins is indicated on the chart. Some pressure recorders are computerized and do not have a paper chart.

A-4. Four Basic Well Tests.

The general purpose for conducting a well test is usually defined within the name of the test. While requirements may differ, the four basic tests, along with preparation and purposes are:

Potential test.

- Requires a 24 hour shut-in period prior to testing.
- Is performed on new wells and wells that have been worked over.
- Purpose: To determine the maximum 24-hour potential capability of a well to produce oil, gas, and water.

Daily test.

- Requires normalizing prior to testing.
- Is performed one time every month on a continuing schedule for the life of the well.
- Purpose: To determine how much fluid the well is producing daily within a month without affecting the well's ability to continue to produce fluids.

Productivity test.

- Requires normalizing prior to testing.
- Evaluates the well in various modes and cycles of operation.
- Purpose: To determine the best way to produce the most hydrocarbons with the least damage to the well's ability.

Gas/oil ratio test.
- Requires a 24 hour shut-in period prior to testing.
- Reveals when wells produce too much gas, which prematurely lowers reservoir pressure and affects all wells in the reservoir.
- Purpose: To determine how many cubic feet of gas is produced per barrel of oil.

A-5. Typical Test Information.

Every test will require that the amounts of oil and water produced be recorded. Gas production is recorded except for producing stripper wells where casing valves are open to the atmosphere. Wellhead pressures of tubing and casing are recorded on all flowing wells.

Lease information (typical for all tests.)

- Company name (may already be on form)
- Field
- Lease name
- Number of well to be tested
- Date test started
- Completion date
- Type of test
- Method of producing well or type of lift
- Conditions before test (shut-in or producing)
- Hours produced
- Oil produced
- Free water produced
- Total fluid produced
- Gas produced
- Temperature of gas
- Oil BS&W content of produced oil
- Gravity of oil
- Temperature of oil
- Gas/oil ratio
- Comments

Well information.
- Method of production (flowing, plunger lift, gas lift, etc.)
- Tubing shut-in pressure before test
- Tubing pressure at end of test
- Casing shut-in pressure before test
- Casing pressure at end of test
- Packer information (if used)
- Choke description and setting for test
- Well reaction to flowing
- Appropriate flow artificial lift assistance
- Flow cycle information
- Other information as needed

Pumping well information.
- Stroke length
- Strokes per minute
- Pump bore size
- Flow line pressure
- Casing pressure if appropriate
- Pumping cycles
- Special pumping information

Tank battery information.
- Lines switched correctly
- Initial tank gauges or meters read and tank number recorded
- Tank size
- Oil and water levels in test tank determined
- Gas line size
- Correct orifice plate installed.
- New gas chart placed on meter
- Other appropriate preparation
- Vessel pressure and temperature recorded as needed
- Comments

Special data.
- Intermittent data
- Interval data
- Injection time and pressure

- Power fluid injected and description
- Special lift information
- Meter readings

Almost all information gathered in testing any well is common to all tests of that well. Some of the information recorded is critical to some tests because of the varying purposes of the tests. Prior test information, used as a reference only, will save time in setting up the test.